2007 RESEARCH PROBLEM STATEMENT

Problem Title: Accelerated Bridge Construction and prefabricated decks **No.:** 07.08-1

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Project Champion: Boyd Wheeler

(UDOT or FHWA employee who needs this research done, will help the Research Division lead this project, and will spearhead the implementation of the results. If the project gets prioritized at the UTRAC conference, a Champion Commitment Form will be required before funding.)

1. Briefly describe the problem to be addressed.

UDOT has made a strategic decision to pursue Accelerated Bridge Construction techniques. One style of Accelerated Bridge Construction that UDOT is particularly interested in utilizes precast deck panels. Accelerated Bridge Construction has many benefits but requires new construction methods. The major technical problems of rapid construction techniques utilizing precast decks are as follows:

- Making the deck composite with the girder.
- Sealing the joint between panels.
- Connecting the panels.

Currently UDOT has only used full depth precast deck panels on steel girder bridges. All projects have used blockouts in the panels in which shear studs are inserted following placement of the panels. Three methods of connecting the panels have been used, post tensioning, closure pours, and angles embedded in the panel welded after placement. Preliminary review of previous projects shows that the blockouts are cumbersome and slow construction. The closure pours have not performed well, welded joints have leaked and post-tensioning has worked but is expensive and slows construction.

As part of this research we will examine the implications of designing new structures with noncomposite decks and if we can use the deck as a composite element for service loads, but noncomposite for strength loads.

The two objectives of this project are as follows:
1) Develop a deck replacement system which eliminates the blockouts (speeds construction), is appropriate for both prestressed and steel girders and simplifies the connection of the panels (improves long term performance).
2) Determine if new bridges can be designed to behave compositely for service loads and noncompositely for strength loads.

2. Strategic Goal: ☒ Preservation ☒ Operation ☐ Capacity ☒ Safety (check all that apply)

3A. List the research objective(s) to be accomplished:

1. Document performance of existing precast deck bridges.
2. Determine if the proposed methods of making the deck composite and connecting the panels meet UDOTs requirements for service, strength and extreme event performance.
3. Document the implications of having non-composite precast panels on new structures.
4. Determine if simple non-composite deck to girder connections act compositely for service loads.
5. Establish standard design methods and details for placing precast deck panels on existing bridges.
6. Establish design guidelines for new bridges to facilitate deck replacement with precast deck panels.

3B. List the major tasks to accomplish the research objective(s): **Estimated person-hours:** 1440-1900

1. Literature search. (120-200hrs)
2. Review performance of existing projects. (60-80hrs)
3. Analyze the proposed methods to connect the deck to the grinder (240-280)
   - Low profile shear keys in the bottom of the precast deck panel and top of prestressed girder.
   - Low profile shear keys in the bottom of the precast deck panel and existing rebar extending from the top of prestressed girders.
   - Low profile shear keys in the bottom of the precast deck panel and low profile studs or bars welded to steel girders.
   - Bolted connection from the panel to the steel girder.
4. Analyze the proposed method to connect adjacent panels. (240-300hrs)
   - Connect panels with curved bolts (process is currently used in segmental tunnel construction)
   - Use grouted keyways between panels.
   - Use male/female keys between panels with epoxy sealant materials.
   - Use noncomposite decks in new construction.
   - Determine if the deck/girder combination can be designed as composite for service loads and noncomposite for ultimate loads. (*This portion could be a stand alone project.)

5. Analyze the use of noncomposite deck panels. (240-300hrs).
   - Determine if the deck/girder combination can be designed as composite for service loads and noncomposite for ultimate loads.
6. Laboratory testing of proposed connections at Utah State University. (400-500hrs)
7. Write a report outlining the findings of the study. (100-200hrs)
8. Assist UDOT in developing design guidelines and standard drawings. (40hrs)

4. Estimate the cost of this research study including implementation effort (use person-hours from No. 3B): $120,000 to 150,000

5. Indicate type of research and/or development project this is

Large: ☒ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☒ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other: _____

(A small project is usually less than $20,000 and shorter than 6 months)

6. Outline the proposed schedule (when do you need this done, and how will we get there):

Project start, July 2007
Literature search, 8 weeks
Review existing projects, 3 weeks.
Analyze proposed methods, 8 weeks
Test proposed methods, 12 weeks
Write report, 6 weeks
Develop guidelines and standards, 12 weeks
Project completion, Dec 08

7. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, with collaboration with Consultant and UDOT.
Consultant to analyze proposed solutions within the formwork of the LRFD design code.
University to perform literature search, analytical studies, connection laboratory testing and prepare reports.
Consultant/UDOT to develop design guidelines and standard drawings.

8A. What deliverables would you like to receive at the end of this project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Design guidelines and standards.

8B. Describe how this project will be implemented at UDOT.

Design guidelines and standards will be used on Bridge projects.

8C. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Designs will be standardized reducing design costs. The project will determine the best methods for construction, thus minimizing construction time and maximizing long term performance.

9. Describe the expected risks and obstacles as well as the strategies to overcome them.

The major risk in any research project is the deliverable is never used. By creating a team of real world professionals, and academic professionals we will get the best of both worlds to create a document that recognizes the needs of design engineers and is backed by peer reviewed research.

10A. List other people (UDOT and non-UDOT) who are willing to participate in the Technical Advisory Committee (TAC) for this study:

Name	Organization / Division / Region	Phone	Email
	FHWA		

10B. Identify other Utah, regional, or national agencies and other groups that may have an interest in supporting this study:

FHWA Highways for Life program may be interested in this project.